NTI
BUILDING A SAFER WORLD

Innovating Verification: New Tools & New Actors to Reduce Nuclear Risks

Building Global Capacity

PART OF THE *Cultivating Confidence Verification Series*

About the Verification Pilot Project

The Verification Pilot Project of the Nuclear Threat Initiative (NTI) convened technical and policy experts from around the world to develop recommendations for new approaches to verification that could enable future progress on arms reductions. As the two-year project moved forward, it became clear that innovating verification could also prompt near-term progress on non-proliferation and nuclear security.

NTI partnered with senior leaders from the U.S. Departments of Defense, Energy, and State as well as the governments of Norway, Sweden, and the United Kingdom. That dialogue identified the key challenges that became the subjects of the project's three expert working groups, which included more than 40 technical and policy experts from a dozen countries. *Innovating Verification: New Tools & New Actors to Reduce Nuclear Risks* includes an overview and reports from the three working groups:

- The ***Innovating Verification Overview*** includes a foreword by Sam Nunn, NTI's chief executive officer and co-chairman, and key project findings and recommendations across report topics.
- ***Verifying Baseline Declarations of Nuclear Warheads and Materials*** analyzes how baseline declarations can contribute to near- and long-term arms control and non-proliferation goals and how to verify them without compromising sensitive information.
- ***Redefining Societal Verification*** explores how advances in information technologies, big data, social media analytics, and commercial satellite imagery can supplement existing verification efforts by governments and increase contributions from outside experts.
- ***Building Global Capacity*** considers the value of expanded international participation in the verification of nuclear arms reductions and how this participation can increase confidence in nuclear threat reduction efforts among all states.

The project builds on *Cultivating Confidence: Verification, Monitoring, and Enforcement for a World Free of Nuclear Weapons* (Nuclear Threat Initiative, 2010), which outlined key issues that states need to address to ensure that nuclear weapons reductions can proceed in a safe and transparent manner.

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July 2014

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Members of the Nuclear Threat Initiative's Verification Pilot Project endorse the general tenor of this report but were not asked to support each individual finding and recommendation. The views expressed in this report do not reflect those of the institutions with which the working group members are associated. Their affiliations are listed for the purpose of identification only.

1. Executive Summary

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) includes a set of fundamental commitments: all parties will take steps toward disarmament, countries without nuclear weapons will not acquire them, and all countries can benefit from peaceful nuclear energy. All states have responsibilities and a vested interest in ensuring that the goals of the treaty are met.

States with nuclear weapons will be less likely to pursue deep reductions if more states acquire nuclear weapons or latent nuclear weapons capability because of the spread of uranium enrichment and plutonium reprocessing technologies. Non–nuclear weapon states (NNWS) thus have both an individual interest and a collective responsibility to ensure that the goals of the treaty are met, including through constraints on sensitive fuel cycle facilities to preclude the development of nuclear weapons programs. NNWS will be less likely to accept such constraints if they perceive that nuclear weapon states (NWS) are not taking their disarmament commitments seriously or, worse, are misleading the international community about their nuclear weapons reductions. All states have compelling reasons to hold the others accountable for their actions. For NWS, demonstrating compliance builds trust; for NNWS, being able to participate in some measure of verification is the most effective form of reassurance and allows them to appreciate the challenges NWS face in reducing their nuclear stockpiles. Further, states not party to the NPT have a stake in helping to develop and engage in verification of nuclear commitments, especially those that might relate to regional arrangements.

Verifying nuclear arms reductions is a highly complex and sensitive undertaking. Historically, states with nuclear weapons have tended to resist engagement with states without nuclear weapons due to concerns that sensitive information may be revealed in the process. Practical examples and joint projects help demonstrate that there is a great deal states without nuclear weapons can be involved with while successfully managing proliferation risks.

While reducing nuclear risks and ensuring that arms reduction commitments are being fulfilled are goals shared by all, individual countries' level of interest in arms control verification and technical capacity to participate in verification activities vary greatly and will change over time.

There are significant gaps at the national level in most countries when it comes to mobilizing and organizing the relevant technical and administrative skills, yet it might surprise some to realize that many of these skills already exist in most countries. For example, technologies used for nuclear medicine and remote sensing and geospatial data software can be applied to verification missions. A systematic process to define gaps and fill them—to build capacity—would allow new states to join verification and monitoring efforts when they are ready. There is evidence from past experimental projects that some states without nuclear weapons would show immediate interest in a focused dialogue on verification, if given the opportunity. For many other states, the consensus judgment of other, trusted countries would provide sufficient reassurance. Capacity building is not, however, a synonym for technical training; existing skills need to be brought together in a framework dedicated to arms control. This process will take years, so interested parties should start now.

There are significant gaps when it comes to mobilizing and organizing relevant technical and administrative skills, yet many of these skills already exist in most countries.

RECOMMENDATIONS

Recommendations are grouped in three categories for states with nuclear weapons, states without nuclear weapons, and both groups collectively that will help to create a sense of common enterprise and solidarity.

States with nuclear weapons should

- **Determine national inspection sensitivities.** If states with nuclear weapons intend to work with states without nuclear weapons, they need to begin by ascertaining what knowledge, methodologies, and technologies can be shared without revealing sensitive information that could contribute to proliferation.
- **Establish, reestablish, or expand government programs dedicated to verification.** Dedicated government programs are required to devote the necessary resources to the task and ensure efforts are sustainable over the long haul.
- **Share information on risk management associated with inspections.** States with nuclear weapons can learn a great deal from each other about how inspections at sensitive facilities are managed. Sharing lessons learned will be useful and, eventually, will facilitate engagement with states without nuclear weapons.

- **Preserve program records, supporting data, knowledge, and institutional memory.** As the experience of South Africa, described in this report, shows, better documentation can increase the level of confidence in verification findings and reduce workloads. Maintaining clear and consistent records makes demonstrating compliance much easier.
- **Engage all nuclear-armed states in the dialogue on the glossary of concepts and definitions applied in nuclear arms control.** The NWS are developing a common understanding of concepts and definitions that will be helpful in streamlining collaborative nuclear activities. Engaging other nuclear-armed states on this topic could be a productive next step and build broader capacity for verification.
- **Evaluate how to make unilateral modifications to force size, structure, and posture more transparent.** Such actions have near-term benefits to confidence and long-term value by creating working relationships, demonstrating proof of concept for greater openness, and building a catalogue of tools and procedures that could be brought into future verification activities.

States without nuclear weapons should

- **Determine what they want to achieve from engagement in a verification process.** States without nuclear weapons need to develop a basic understanding of the benefits and limitations of verification to determine the value of engaging and the return that can be expected on that investment.
- **Promote academic programs that build verification skill sets.** Promoting specific programs with verification applications will help interested countries build capacity in functional areas.
- **Establish a government program dedicated to verification and identify a lead authority.** Just as in states with nuclear weapons, dedicated government programs in states without nuclear weapons are required to devote the necessary resources to the task and ensure efforts are sustainable over the long haul.

States with and without nuclear weapons collectively should

- **Share basic information related to definitions, methodologies, instruments, and relevant technologies.** Sharing basic information helps to facilitate cooperation by identifying similarities and differences and minimizing miscommunications.
- **Jointly develop academic curricula that build awareness about verification concepts.** Academic programs should provide basic knowledge, build capacity in functional areas, and promote sustainability.

- **Conduct site visits at nuclear facilities.** Preliminary site visits will help to acclimate hosts and visitors to safety and security requirements. This is sometimes referred to as managed access.
- **Share experiences and lessons learned from existing verification activities.** Experiences should not be limited to the nuclear realm and could include regimes such as the Chemical Weapons Convention.
- **Explore regional approaches to capacity building.** Different countries possess different skills that can be found in the government, military, academic, and private sectors. These should be brought together. Useful first steps include identifying regional champions for the verification mission and establishing a group of interested parties that will conduct joint outreach on verification issues through activities such as dedicated workshops.
- **Design and conduct a mock inspector training course.** This course could be modeled on the New Strategic Arms Reduction Treaty (New START) inspection regime, open to participation from states with and without nuclear weapons, and designed to share lessons learned from decades of U.S. and Russian experience.
- **Conduct joint development, testing, and certification of verification tools and nuclear forensics.** Joint development is an extremely effective way to build both knowledge and trust among partners.
- **Develop common understandings of information security processes and procedures.** Even if the information security processes of interested countries are not similar, understanding the similarities and differences will make cooperation much easier.

2. The Evolution of Nuclear Arms Control Verification

The task of verification is to gather and apply information to form a judgment about a country's performance regarding its commitments and obligations to manage or reduce nuclear weapons and materials. The key elements of verification are monitoring—that is, generating the information on which a judgment can be based—and a methodology for determining whether actions match expectations. The sustained engagement that a verification regime demands is also a means to build trust between partners, even when the political relationship sours.

Between 1968 and 1972, when several landmark bilateral and multilateral agreements were reached, detailed and intrusive verification under international supervision and control was not politically achievable. However, treaties of that time recognized that applying the technical means that were then available was valid and useful. The parties recognized the utility of national technical means, and in some cases promised not to interfere with their application by concealment or spoofing.[1]

Arms control and disarmament agreements of the late 1980s and early 1990s took a different view of verification requirements. Agreements such as the Intermediate-Range Nuclear Forces Treaty, Strategic Arms Reduction Treaty (START) and the Chemical Weapons Convention (CWC) elaborated extensive and detailed provisions for verification, including joint bodies and in the case of the CWC, an international organization to support the process.

Verification needs to be tailored to the political and strategic conditions in which specific agreements are reached. Methodologies and techniques such as on-site inspection or perimeter and portal monitoring were already known in the late 1960s and early 1970s. That they were not used did not reflect technical limitations; they went beyond what was politically acceptable to decision makers of that time. If negotiators had insisted that agreements such as the Anti-Ballistic Missile Treaty or the Biological and

Toxin Weapons Convention (BTWC) incorporate all that was technically feasible, they would have made verification into an insurmountable obstacle to agreement rather than an enabler.

Ultimately, the precise ways in which verification methodologies, techniques, instruments, and equipment will be applied in future agreements cannot be known today. To ensure that relevant knowledge, skills, and technologies are available when required, they need to be broadly applicable as well as sustained and organized in cost-effective and efficient ways.

NUCLEAR FORCE REDUCTIONS: PAST EXPERIENCE AND NEAR-TERM EXPECTATIONS

The verification paradigm is well embedded into the discourse on nuclear arms control. In 2008 UN Secretary-General Ban Ki-moon insisted that any agreements must be "backed by a strong system of verification."[2] In the final document from the NPT Review Conference in 2010, the participating states demanded "an effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices."[3] On June 19, 2013, U.S. President Barack Obama called for a new round of bilateral negotiations between the United States and Russia with the objective of further reducing the levels of deployed nuclear weapons below the ceilings contained in the 2010 New Strategic Arms Reduction Treaty (New START). The chief U.S. negotiator, then-acting under secretary for arms control and international security Rose Gottemoeller, has asserted that the best treaties in the world "are only as good as the verification regimes."[4]

The same theme is prominent in expert writing. In the discussions of a putative weapons of mass destruction–free zone in the Middle East, a recurring theme is that "the Zone could realistically be negotiated, or even established, only through sui generis Middle East specific modalities, not in the least in the domain of verification."[5] Looking at what can reasonably be expected in the coming years, however, most officials and observers tend to lower near-term expectations that agreements will be negotiated, whether bilateral, regional, or global. The next few years seem likely to be spent preparing for future agreements.

Meanwhile, even in the absence of new arms control agreements, nuclear force structures will continue to evolve, including measures that involve the reduction, or even elimination, of certain types of nuclear weapons from military arsenals. The changes in the size and deployment patterns of Russian and U.S. nuclear forces after the end of the Cold War provide well-known examples of such unilateral reductions.[6] The United States has retired the nuclear-armed Tomahawk land-attack cruise missile (TLAM/N),[7] and France and the United Kingdom have decided to eliminate one or more legs of their nuclear force structures.[8] France also decided to close significant parts of its nuclear

weapons complex, including facilities to produce fissile material and nuclear weapon test sites.

Other unilateral changes to nuclear forces are sketched out below: the elimination of nuclear weapons by South Africa, the implementation of President George H. W. Bush's initiative to remove U.S. nuclear weapons deployed on the Korean Peninsula, and the United Kingdom's ongoing reductions of nuclear weapons. None of these was subject to verification at the time of implementation, yet there seems to be a high degree of international trust that the reductions have in fact occurred.

South Africa: Verifying a Secret Program

In 1989 South African President F. W. De Klerk appointed a steering committee to oversee the dismantling of the nuclear weapons that South Africa produced. Both the nuclear weapons program and the dismantlement process were kept secret.[9]

Even in the absence of new arms control agreements, nuclear force structures will continue to evolve, including the reduction or elimination of certain types of nuclear weapons.

The committee was given the mandate to dismantle six fission nuclear explosive devices under safe and controlled conditions, then to melt and recast the highly enriched uranium (HEU) extracted from the six devices, along with HEU for a seventh device that was never fully assembled, into shapes that would not be suitable for use in a nuclear weapon. The recast metal was then turned over to the custody of the Atomic Energy Corporation of South Africa (AEC). All the hardware associated with the devices was destroyed or rendered harmless. Non-nuclear elements of the nuclear weapons program infrastructure were also converted to other activities—for the most part, conventional military uses.

According to the South African government, the dismantlement program was completed by mid-1991.[10] By this time, the international community suspected that the South African program existed. Negotiations with the International Atomic Energy Agency (IAEA) to support South Africa joining the NPT had been ongoing since 1988.[11] When the metal extracted from the South African weapons was turned over to the custody of the AEC at the beginning of September 1991, South Africa signed a comprehensive safeguards agreement with the IAEA and joined the NPT as a non–nuclear weapon state (NNWS). South Africa declared the uranium metal to the IAEA as required under their newly signed safeguards agreement but did not explain where the material came from.

South Africa was not obligated to reveal its past activities in order to comply with its safeguards obligations, and the IAEA was not allowed to reveal any details of its inspection results, despite growing suspicions of the inspectors that the origin of the South African material was a nuclear weapons program. Following public speculation, however, in 1993 South Africa revealed the existence of the program and asked the IAEA to

Source: International Atomic Energy Agency

South African nuclear test shafts being filled in under IAEA supervision.

certify the destruction of the weapons.[12] In carrying out this task, the IAEA representatives found that most warhead records were unavailable, having been lost or destroyed. During the dismantlement process, further significant evidence had been lost, such as from the non-nuclear parts of the program. Additionally, many key people had left the program, making reconstruction of the history even more difficult. An immediate conundrum for the IAEA was related to the 80 to 90 percent enriched uranium-235. The IAEA was asked to certify that South Africa built and destroyed a specified number of weapons but had not been able to observe the dismantlement process, so the amount of material present could conceivably have been extracted from more weapons of a different design.[13]

South Africa also set conditions for the work of the IAEA, including a bar on questions about the weapon delivery systems. Bombs and other delivery vehicles could not be inspected. Security was also a concern for the inspections. Neither South Africa nor the IAEA wanted nuclear-weapon design information to be transmitted to members of the international IAEA team, largely personnel from NNWS. The IAEA solved this problem by using inspectors with weapons clearances in their home states, although verifying this status was informal.

Despite the hurdles, over eight months, the IAEA team became convinced that South Africa's explanation of how its nuclear weapons program was dismantled was correct.[14] The finding largely reflected the internal consistency in the information gathered through site visits, interviews, and available nuclear material accountancy records. The

degree of South Africa's voluntary cooperation was also a factor building trust. At the same time, if better documentation had been available, it would have increased the level of confidence in the finding and reduced the workload of the verification team.

United States: Removing Nuclear Forces on the Korean Peninsula

In February 2013 the Democratic People's Republic of Korea (DPRK or North Korea) announced that it had tested a nuclear explosive device, following previous tests in 2006 and 2009.[15] The test once again highlighted the unresolved issue of how to ensure security and stability on the Korean Peninsula in the shadow of North Korean nuclear weapons development.

The issue of nuclear weapons and the Korean Peninsula has deep roots in the Cold War, during which the United States stationed nuclear weapons in the Republic of Korea (ROK or South Korea). In September 1991 the United States very suddenly removed its weapons from the ROK as part of the Presidential Nuclear Initiative (PNI) of George H. W. Bush. He announced the decision to withdraw tactical nuclear weapons, beginning with ground-based rocket systems and naval tactical nuclear weapons.[16] The removal was never verified; it was a unilateral statement by the president and implemented entirely under U.S. responsibility. Information about PNI implementation in South Korea has been placed in the public domain through Freedom of Information Act requests made by academic and civil society organizations.

The DPRK always saw the PNI as partial and reversible.[17] The removal of the weapons was never subject to verification, nor was any associated decommissioning or dismantlement, and the main elements of the basing infrastructure needed to support the rapid regeneration and redeployment of naval nuclear weapons were not dismantled.[18] Therefore, as far as North Korea was concerned, the nuclear forces that were removed under a political initiative could just as easily be returned to the region by another political decision.

Meanwhile, North Korea was being called to eliminate—with full transparency and intrusive verification—what was, at that time, a suspected nuclear weapons program. Given the nature of the political relationship, it was perhaps reasonable for the North Korean leadership to doubt the truth of the U.S. statement and interpret the overall approach as an attempt to maintain a one-sided advantage in the nuclear field.

Within the wider international community, however, there does not seem to be any doubt about the implementation of the PNI by the United States. It is generally assumed that the weapons were removed, and while the ultimate fate of the specific weapons concerned is not verified, in many cases the launch systems for them are no longer in the U.S. military inventory—another form of confirmation that the PNI was implemented.

United Kingdom: Reducing the Nuclear Arsenal

In October 2010 U.K. Prime Minister David Cameron said that a policy review indicated that the country could meet its deterrence requirements effectively with a smaller nuclear force. Therefore, over the next few years the number of deployed nuclear weapons would be reduced, and plans for a successor nuclear force would use this new, lower baseline.[19] Defence Secretary Liam Fox announced the commencement of the program to implement the reductions in June 2011.[20] At that time, Fox noted that since the U.K. government does not comment on nuclear operations, there would be no updates on the implementation of the program of reductions, though an announcement would be made when it was complete. The public statements included information that the number of warheads on board each Vanguard Class submarine would be reduced from "a maximum of 48 to a maximum of 40," the number of operational missiles on the submarines would be reduced to "no more than eight," and the number of operational warheads would be reduced from "fewer than 160 to no more than 120." The total stockpile would be "no more than 180 warheads" once the overall program was complete.

None of the commitments announced by U.K. officials will be verified. Since 2008 the United Kingdom has been one of the countries that have worked consistently to reinvigorate nuclear arms control, and in general terms, the United Kingdom's good faith in

Source: U.K. Ministry of Defence

The United Kingdom will be reducing the number of Vanguard submarines, pictured above, and the number of warheads on each submarine.

implementing these changes is not challenged. Nevertheless, legitimate questions can be raised about the process and outcome of the current reductions. In particular, states may have a strong and legitimate interest in understanding how quickly the planned nuclear reductions could be reversed.

From Secretary Fox's generic statement there is no way of knowing with certainty where warheads would be removed from missiles, where they would be stored, and in what condition—intact or dismantled—and if dismantled, what that would mean in more specific terms. If the warheads were to be dismantled, understanding the final disposition of the fissile material that they contained would also be of considerable interest to a wider community.

As noted above, the United Kingdom has been in the forefront of states arguing that nuclear arms reductions can contribute to building and preserving international stability and security. Secretary Fox's statement that no questions related to the process of nuclear arms reduction would be answered may have been intended to avoid becoming trapped on a transparency treadmill: answering a given question may not end the process of inquiry but simply unlock additional follow-on questions. Nevertheless, without any agreed understanding about reasonable transparency related to unilateral undertakings, the diplomatic value of announcing a national decision to reduce nuclear forces may be undermined.

CREDIBILITY AND TRUST IN UNILATERAL DECLARATIONS

In the South African, South Korean, and U.K. cases, several factors influence the credibility of the announcements for other observers. First, a nuclear-armed state unilaterally announcing a change in force structure or posture because it has decided that—using its own national methodology and metrics—the announced changes do not weaken its deterrence or defense posture, is by itself a fairly significant indication that the intention to make a change is real, rather than an act of deception. For states that do not acknowledge the existence of nuclear weapons or provide any details of their deployment posture, the situation is far more difficult. If the overall deterrence posture is not known, there is no way to assess the effect of changes.

Second, a country that is generally recognized to take the national implementation of its obligations seriously will probably face lower barriers in making the case to the wider community. International political perceptions are connected to the past record. The loss of a country's reputation if a unilateral statement proves to be false could be very high, damaging important economic and political interests. This risk can be considered a deterrent to false statements.

Third, the strategic credibility of an announcement also partly determines whether an unverified unilateral statement is considered true. The security environment of the country concerned influences this judgment. If the environment is recognized to have improved significantly—as was the case for South Africa and the United Kingdom—then it is likely that the requirement for previous levels of nuclear forces could also change. The missions assigned to nuclear weapons might no longer be relevant, or the remaining forces might be recognized as sufficient to complete the mission in changed circumstances. Equally, if a change in nuclear forces was relatively minor in the context of the overall nuclear or wider military capabilities available to the country concerned, then the incentives to make a false statement would be seen to be low.

Fourth, whether or not a country has a security assurance from a regional or global power also plays a role in determining credibility. The likelihood that a country would be making unilateral modifications to its nuclear posture would be higher if the country concerned were not expecting to face serious security challenges alone.

Finally, the domestic political environment is important. Where there is an open and inquisitive media and a political opposition that expects to be in office at some future date, both the likelihood of exposure and the political cost to a government of lying would be high. This risk represents a considerable deterrent. Risk of exposure could also come about following a challenge by another state. Given that countries monitor one another using whatever national technical means are available to them, a false statement might be exposed.

The cases above suggest that the wider international community trusts at least some unverified, unilateral decisions to modify nuclear force postures and nuclear forces. However, there are no established criteria for determining the credibility of unilateral declarations. Assessing what those criteria might be is a task that would naturally have to involve both nuclear weapon states and non–nuclear weapon states. A unilateral declaration and its implementation can be structured in ways that strengthen confidence in its veracity. This could ultimately include the involvement of third parties.

Nuclear-armed states have received very little political credit from the wider international community for the extremely large cuts they have already made in nuclear forces below Cold War levels. A policy of greater inclusion and transparency might change the political dynamics of the nuclear arms control discussion by generating more of a spirit of solidarity and cooperation.

There may be an advantage of increased transparency regarding unilateral actions in terms of strategic stability. Since the information provided via unilateral statements is likely to be limited, there is a risk that such statements may not reduce security concerns felt by other states about levels of nuclear armament. In a worst case scenario, a unilateral statement that lacks credibility might even exacerbate such concerns, if other states feel that they are being misled.

Incorporating others into a verification regime for unilateral reductions would be complicated, even if the countries concerned were close partners. It may be that the learning process is first and foremost an internal one for the state conducting the reductions. Countries that are implementing unilateral reductions or eliminations could analyze the costs and benefits of lessons gained from arms reductions and determine which of these could be shared with others. The analysis could include the potential benefits of including others in the process as well as the benefits derived from further strengthening the credibility of unilateral changes.

States with nuclear weapons should consider seriously how they could, as a matter of routine, help make modifications to force size, structure, and posture more transparent. Such actions would likely raise challenges, but overcoming them can have near-term benefits to confidence and long-term value by creating working relationships, demonstrating proof of concept for greater openness and building a catalogue of tools and procedures that could be brought into future, more formal verification and monitoring activities.

Short of formal monitoring and verification, engagement and transparency can also help build confidence that states are meeting commitments. There are very few allegations that parties to the BTWC maintain offensive biological weapons programs. The most egregious violator of the treaty—the Soviet Union—went undetected for around 15 years and was only revealed at the end of the Cold War. But Russia is now widely seen as being BTWC compliant, even though Moscow has done nothing to formally demonstrate how its illegal offensive biological weapons program was shut down and dismantled. Perceptions of the Russian program have been changed through a wide range of engagement, including with the scientific community in Russia and other states of the former Soviet Union, rather than through formal verification.

3. The Role of States Without Nuclear Weapons

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) includes a set of fundamental commitments: all parties will take steps towards disarmament, countries without nuclear weapons will not acquire them, and all countries can benefit from peaceful nuclear energy.

States with nuclear weapons will be less likely to pursue deep reductions if more states acquire nuclear weapons or latent nuclear weapons capability because of the spread of uranium enrichment and plutonium reprocessing technologies. Non–nuclear weapon states (NNWS) thus have both an individual interest and a collective responsibility to ensure that the goals of the treaty are met, including through constraints on sensitive fuel cycle facilities to preclude the development of nuclear weapons programs. NNWS will be less likely to accept such constraints if they perceive that nuclear weapon states (NWS) are not taking their disarmament commitments seriously or, worse, are misleading the international community about their nuclear weapons reductions.

All states, including those not party to the NPT, have compelling reasons to hold others accountable for their actions. For states with nuclear weapons, demonstrating compliance builds trust (even among themselves); for states without nuclear weapons, being able to participate in verification is the most effective form of reassurance and allows them to appreciate the challenges nuclear-armed states face in reducing their nuclear stockpiles. This dynamic becomes even more pronounced if deep reductions take place in a multilateral setting. If states with nuclear weapons want the international community to be with them on the landing of a world without nuclear weapons, they need to ensure that the international community is with them on the takeoff.

There is a broad consensus that as nuclear arms reductions progressively shrink the number of nuclear weapons in the world, a more inclusive approach to verification will be needed. As the numbers of nuclear weapons fall, the potential advantages of cheating increase, as any country that can hide even a few nuclear warheads can alter

Source: U.S. Department of State

U.S. Secretary of State John Kerry and Russian Foreign Minister Sergey Lavrov in Geneva, Switzerland, in April 2014.

the nuclear balance. Such a failure of verification would be enormously destabilizing for the entire international community. Thus, many constituencies have a shared interest in eliminating misunderstandings, preventing the spread of misinformation, and detecting proliferation as early as possible. However, not all states without nuclear weapons are interested in playing a role in verifying arms control agreements; if the parties to those agreements are confident that commitments are being fulfilled, many countries will have little reason to be any less confident.

But negotiating nuclear reductions is a complex task. Arms control is underpinned by common and cooperative security, as articulated in the 1982 Palme Commission report, which noted that "states can no longer seek security at each other's expense; it can be obtained only through cooperative undertakings."[21] However, when discussing a specific mandate for negotiations, states have a natural tendency to try to restrict capabilities that are seen as threatening, while trying to avoid, to the extent possible, restrictions on capabilities in which they possess an advantage or that are seen as necessary for defense. The actors in the arms control process are thus both partners and adversaries. Trust cannot be assumed and is largely subjective, suggesting predictable behavior—either positive ("good") or negative ("bad") behavior.[22]

The best example of the partner-adversary dynamic can be found in the long history of U.S.-Russian arms control negotiations. Most recently, statements by Russian Foreign Minister Sergey Lavrov and U.S. Secretary of State John Kerry have underlined that

both parties to the New START Treaty are fully satisfied that the treaty's verification regime—which Lavrov has called the "gold standard"—works.[23] With the state parties in agreement, there is no evidence that the wider international community mistrusts the implementation of New START.

States armed with nuclear weapons have begun to look beyond the existing bilateral framework in which reductions of strategic nuclear weapons are negotiated. Senior Russian officials have recently emphasized that the three other NPT nuclear weapon states—China, France, and the United Kingdom—should soon be drawn into the U.S.-Russia dialogue on reduction of strategic nuclear weapons, initially perhaps through a political commitment not to increase their nuclear forces and without verification measures. Beyond that, Russian officials have emphasized the need to include all countries with "significant nuclear-weapon capabilities."[24]

Developing a common understanding among interested states on a generic set of capabilities for monitoring and for administration is timely because capacity building is complex and lengthy.

If additional states are incorporated into negotiating nuclear arms reductions, will the wider international community be as confident about the integrity and competence of the processes being applied? It is possible to find examples of diverse partners gaining confidence through active cooperation in mutual transparency, such as the Hexapartite Safeguards Project and the United Kingdom–Norway Initiative on Nuclear Warhead Dismantlement Verification (described in this chapter). But even if there are no immediate prospects for early movement to a more inclusive legal agreement on reductions, developing a common understanding among all interested states on a generic set of capabilities for monitoring (collecting and analyzing information) and for administration (the management and implementation of the collection process and the methodologies for analysis) is timely because capacity building is a complex and lengthy undertaking. These capabilities will be needed, though the ways they are combined will be tailored to the specifics of a future agreement.

States with the technical capacity to make their own verification-related judgments can act alone, using proprietary information. However, doing so runs the risk that others will see the findings as one-sided and politically motivated, undermining their credibility even when made in good faith.

The NWS-NNWS Divide

In most respects, the five NWS as recognized by the NPT—China, France, Russia, the United Kingdom, and the United States—are heterogeneous. They share relatively few characteristics beyond ownership of nuclear weapons and do not even agree on many of the fundamental concepts and definitions that are applied in nuclear arms control. When the dialogue expands to include all states armed with nuclear weapons, the diversity becomes even greater.

China is leading a working group of the NWS tasked with creating a glossary to be presented at the 2015 NPT review conference. Engaging other countries in a dialogue on the glossary once the document has been completed could be a useful next step. Among NNWS, there are countries that are allied with nuclear-armed states and incorporate extended deterrence into their preparations for national security. Some of these states have nuclear weapons located permanently on their territory. Some operate complex nuclear fuel cycles that provide them with the technical capacity to develop a nuclear weapons program. Others generate nuclear power but do not operate enrichment and reprocessing facilities. Some are situated in the vicinity of either nuclear-armed states or states with advanced fuel cycles. Finally, there are countries with little or no direct exposure to nuclear issues, but with interests that would be affected by any use or serious threat of use of nuclear weapons.

The diversity among NNWS is often overlooked, and when NWS and NNWS try to interact with one another as distinct groups, the result is often unconstructive. As former secretary of state George P. Shultz, former secretary of defense William J. Perry, former secretary of state Henry A. Kissinger, and former senator Sam Nunn noted in *The Wall Street Journal* in January 2007, the NPT envisioned the end of all nuclear weapons but even though every United States president since Richard Nixon has reaffirmed that commitment, "non–nuclear weapon states have grown increasingly skeptical of the sincerity of the nuclear powers."[25] This skepticism exists despite continuous, large-scale reductions in the numbers of nuclear weapons since 1991.

There is no authoritative global inventory of nuclear weapons, but the data published by the Stockholm International Peace Research Institute (SIPRI) suggests that the total number of nuclear weapons in the world has fallen by roughly 40 percent since 2005. In the same period,* the number of nuclear weapons considered to be deployed—either placed on missiles or co-located with operational forces with an identified nuclear mission—has fallen by well over 60 percent.[26] Rather than being interpreted as part of an orderly movement toward nuclear disarmament, however, these reductions are seen in the context of creating leaner and more efficient nuclear forces to be held in perpetuity. As a result, many NNWS do not give credit to nuclear weapons states for their efforts.

On the flip side, the NPT was signed at a time when the pursuit and exploitation of sensitive fuel cycle technology, equipment, and know-how was assumed to be beyond the reach of all but a very few countries, and it was believed that sensitive information related to the nuclear fuel cycle could be protected and contained. This presumption has been proven to be unfounded. There is currently much greater need for certainty when suspicions arise that some NNWS intend to acquire the expertise and technology to enrich uranium and/or reprocess spent fuel for ostensibly peaceful purposes, precisely because they may serve as the basis for development of a nuclear weapons program in the future. That recent innovations intended to make strategic trade controls and

* The number of nuclear weapons in the world in 2005 was itself only a small share of the number that existed at the height of the Cold War.

Source: Lyndon B. Johnson Presidential Library

Secretary of State Dean Rusk prepares to sign the NPT on July 1, 1968.

safeguards more effective have not been universally accepted has done nothing to boost confidence that the regime is being continuously improved.

One manifestation of this "trust gap" between NWS and NNWS has been increasingly ritualized confrontations, where complaints against the established nuclear weapons powers over lack of progress on arms reductions are immediately met by counter-complaints about the failure of the NPT to provide foolproof ways of detecting and stopping suspected cases of proliferation. Meanwhile, within the international community, a relatively small group of countries are applying major resources in a systematic way to monitor nuclear forces. Many more have technical capabilities that could be applied for that purpose, and the number of states with those capabilities is growing, as they employ commercial high-resolution imagery and other geospatial tools for environmental monitoring and urban planning. If groups of motivated and willing states work together to take practical actions, then the tendency for NWS and NNWS to be seen as working in separate silos can be effectively broken down.

The Hexapartite Safeguards Project and U.K.-Norway Initiative

Past collaborative work between NWS and NNWS shows how participants can achieve mutually satisfactory outcomes while protecting highly sensitive economic and security information in ways that might also reassure non-participants. From 1980 to 1983 the Hexapartite Safeguards Project linked the URENCO countries—Germany, the

Netherlands, and the United Kingdom—with Japan, Australia, and the United States in a project to analyze the best way to carry out safeguards inspections in centrifuge enrichment plants. The European Atomic Energy Community (Euratom) and the IAEA were observers. The project was the first to treat NWS and NNWS equally in the safeguards domain, designing a safeguards approach that was subsequently introduced at all URENCO sites, including providing access to centrifuge halls.[27]

The participants had a common interest in safeguarding uranium enrichment plants with a minimum of inconvenience. All owned very sensitive enrichment technology that is protected by national law and could represent a serious loss of commercial advantage, if compromised. Euratom and IAEA participation meant that a host of nationals of countries other than the six were involved in setting inspection procedures and accessing many aspects of uranium enrichment technology. Furthermore, the parties used different technologies. The United States had extremely large and expensive centrifuges, while URENCO concentrated on smaller, less sophisticated devices.

The safeguards approach could not be identical across facilities, but met the same standard in all cases: creating effective safeguards without compromising commercially or proliferation sensitive information. The approach is a model for cooperative nuclear weapons dismantlement. When countries work together and have common rules, even if the players vary, it should increase the confidence of outsiders through acknowledgment that the countries with the greatest stakes are satisfied that the outcome is fair.

Source: URENCO

The Hexapartite Safeguards Project analyzed how best to carry out safeguards inspections in centrifuge enrichment plants.

Similarly, the U.K.-Norway Initiative on Nuclear Warhead Dismantlement Verification focused on the technical dimensions of NWS-NNWS cooperation. The initiative grew out of a U.K. government expression of interest in exploring opportunities for interchange with other governments and state organizations regarding nuclear arms control verification at the 2005 NPT Review Conference. The Norwegian government responded positively and was deemed an ideal NNWS partner given its extensive experience in nuclear research and the preexisting level of trust between the two countries. The bilateral initiative was designed to increase NNWS awareness and understanding of "the technical complexities, proliferation concerns and further work required in addressing the verification of any future nuclear warhead dismantlement regime and to enhance transparency and build mutual confidence through openness, cooperation, education, and outreach."[28]

The United Kingdom and Norway, with the Verification Research, Training and Information Centre (VERTIC) acting as an independent observer, commenced in 2007 by pursuing a two-track approach. The first track explored possible verification procedures applicable to a NNWS inspecting a voluntary warhead dismantlement process in a NWS. The second demonstrated the feasibility of jointly developing a simple technical tool to authenticate the nuclear component of the weapon without revealing proliferation-sensitive information.

Source: The Norwegian Defence Research Establishment

The U.K.-Norway Initiative included a mock gravity bomb inspection.

Inventively, the United Kingdom played the role of a fictional NNWS and Norway played the role of a fictional NWS, giving participants the opportunity to view the problem from the other side's point of view. After a long period of preparatory consultations, collaborative exercises took place in Norway in 2008 and 2009 to familiarize the U.K. team with Norway's procedures and facilities and to simulate the dismantlement of a mock gravity bomb. In 2010 the mock gravity bomb was inspected again, but the parties swapped roles and the exercise took place at one of the U.K.'s Atomic Weapons Establishment facilities to more realistically simulate the security and safety environment of a real inspection. In addition, the tone was more confrontational, with the NWS instructed to heavily emphasize security as a first priority and be reactive rather than proactive.

The initiative demonstrated that NWS and NNWS can collaborate and successfully manage proliferation risks. U.K. participants remarked that as long as the safety and security requirements are appreciated, there is very little in which NNWS cannot be involved. Sustained engagement proved to be effective in building trust among a group of experts with differing expectations at the outset.

This groundbreaking initiative has a narrow focus. As the participants readily conceded, the initiative addresses only a fraction of the technical areas necessary to achieve high-confidence dismantlement verification, which in itself is only one part of the disarmament process. But the lessons are far-reaching. Encouragingly, in December 2011, the United Kingdom and Norway hosted a workshop for countries that had shown an interest in the initiative: 63 delegates from 12 NNWS and the United States attended.[29]

4. Issues to Address

EXPANDING THE SCOPE OF VERIFICATION

International appetite for expanding the scope of verification processes is tempered by significant skepticism about how countries reach compliance judgments based on data from monitoring and verification efforts. As evidenced by the different reactions in technical and policy communities to the information available regarding the possible existence of weapons of mass destruction programs in Iraq prior to 2003, more information did not necessarily or automatically increase confidence. More information sometimes reinforced, rather than alleviated, concerns and questions about the conclusions. A dialogue between technical and policy communities on how each group interprets and presents information could be mutually beneficial for global efforts to develop and implement credible verification approaches that lead to trusted conclusions.

Parties in good standing with an agreement may no longer be willing to carry the cost of undifferentiated measures designed to catch cheating. The difficult negotiations over the budget of the Organization for the Prohibition on Chemical Weapons, charged with verification in the framework of the Chemical Weapons Convention (CWC), testify to the current reluctance to support costs seen as excessive, even in the global application of measures that are implemented without regard to the different risk perceived to be posed by different countries or activities. Conversely, countries that feel they might be the focus of discriminatory measures are likely to resist engaging in multilateral arrangements. Approaches to verification that are effective but that appropriately optimize the use of resources are needed.

The steady accretion of new verification tools is partly a function of the gradual spread to new countries and communities of knowledge of technical instruments and methodologies that used to be the exclusive domain of great powers. High-quality satellite imagery, previously only available to a small handful of states, is now ubiquitous. Com-

bining this imagery with other geospatial tools that are now commercially accessible to a much broader spectrum of users gives states without nuclear weapons a greater chance to hold others accountable for their unilateral statements or commitments, for example, on changes in nuclear forces.

A coalition of states without nuclear weapons might assemble very credible technical capacity to shed light on such activities. The experience of the participants in the U.K.-Norway Initiative illustrated that the critical question was how to assemble the right mix of expertise, rather than whether individuals were nationals of states with nuclear weapons or states without nuclear weapons. Furthermore, non-governmental expertise could play a role, particularly in the use of publicly available tools. Such expertise could be networked, perhaps even to include participation from the non-governmental sector in the country where official unilateral statements are being examined.

TIMELINESS

As noted above, South African authorities dismantled nuclear explosive devices entirely at their own discretion. An international team was subsequently engaged to verify this through on-site visits to nuclear and non-nuclear facilities associated with the program, through nuclear material accountancy, and interviews with key personnel. While successful, the experience in South Africa underlines the difficulty of determining in retrospect whether declarations are complete in the absence of a transparent process. South Africa's motivations to destroy its stockpile were genuine, the security environment was much improved, and the move to legitimate majority rule was impending. Nevertheless, the ruling political party determined that weapon dismantlement should be secret until it was completed, and then it was revealed only when information was leaked.[30]

A critical question is how to assemble the right mix of expertise, rather than whether individuals are nationals from states with nuclear weapons or states without them.

The availability of accurate warhead documentation would have helped to facilitate the process of ex post facto verification. To be at its most efficient, the process required two-way trust building. South Africa needed to win the trust of the international community. However, those responsible for conducting the verification also needed to win the trust of South African decision makers.

BUILDING FOUNDATIONS FOR PARTNERSHIPS

Nuclear-armed states will have questions of their own that need to be answered before any cooperative process can begin. First, they will want to be certain that the process will not reveal sensitive information that could contribute to proliferation. Information that would reveal details of how a nuclear weapon works poses both a proliferation and national security risk. With the exception of close allies (such as the United States

and United Kingdom), information of this kind is not shared with others, whether or not they have nuclear weapons. This is both a vertical and a horizontal issue in that the process of arms reduction should neither spread information that is proliferation sensitive to new states, nor should it allow a country with nuclear weapons to develop new or improved designs. On the other hand, information that does not pose a proliferation risk can potentially be shared safely with all prospective partners—states with and without nuclear weapons—in the right context, and provided that there is no legal barrier to sharing it.

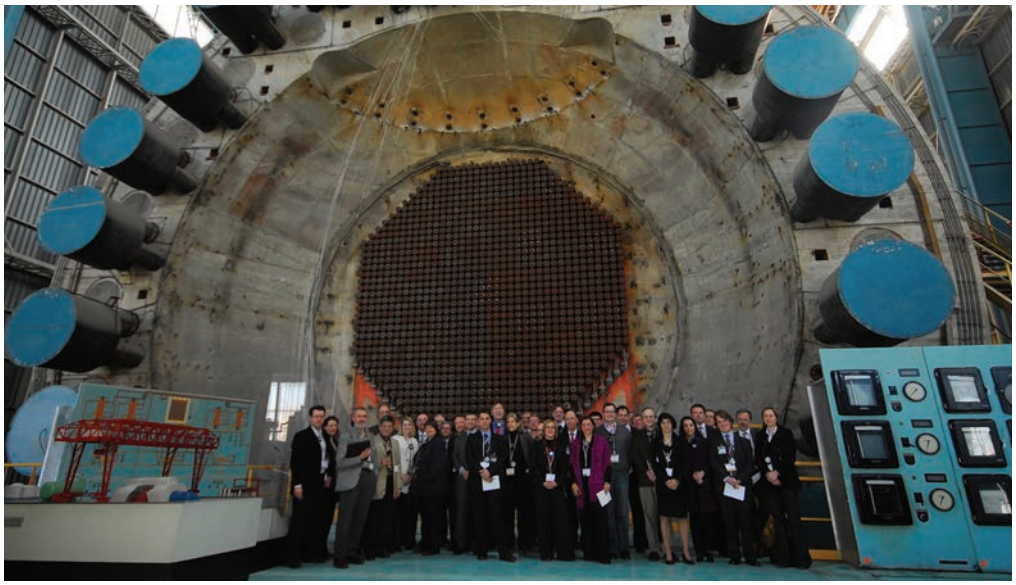
Second, a nuclear-armed state will want to be assured that the prospective partner has the technical skills to engage in the process seriously. These skills might include being able to conduct measurements that indicate the presence or absence of fissile material without revealing sensitive information about the characteristics of the nuclear weapon, including the size and shape of fissile material it contains. The level of sophistication of the technical skills should not be exaggerated, but the partner would need to understand basic nuclear physics and appreciate the difficulty of measuring nuclear material. In addition, states without nuclear weapons will need to demonstrate the ability to manage information securely, including in digital form.

To make and analyze measurements, the partners may need to use certain technical instruments or be in a position to judge others' use of such instrumentation. It will be important that all sides have confidence that the equipment does exactly what is required of it and nothing more. To build that confidence, partners need to be completely open in making equipment available for inspection and testing. The conversion of existing equipment or the use of commercial off-the-shelf products might be suitable for this purpose, but the joint development of test and evaluation equipment might be the best way to build trust and create a useable inventory of instruments.

The cooperation process could involve access to sensitive facilities where the presence of all personnel would be governed by relevant domestic regulations. It would be difficult to deviate from the provisions in the existing set of rules. The participants from partner countries would need to show that they appreciate the health and safety rules that such facilities apply, as well as understand and respect physical security limitations.

LESSONS FROM OUTSIDE THE NUCLEAR WEAPONS REALM

All states, whether or not they are nuclear armed, can engage in a great deal of work. The development of the 1990 Conventional Armed Forces in Europe Treaty (CFE Treaty) required parties with large discrepancies in verification technology and expertise to reach agreement on how to organize inspections and share information. To implement the CWC, states have had to learn how to manage access to sensitive facilities while respecting the need for effective verification. These treaties can be models for planning and conducting inspections, developing a framework of rules for managed access to



Source: CEA

Representatives from non-governmental organizations visit the Pierrelatte enrichment facility in France during dismantlement in March 2009.

facilities, and developing rules and procedures to ensure the chain of custody of relevant items. Outside the context of verifying non-nuclear arms control agreements, states without nuclear weapons could also assess the applicability of knowledge related to implementing site security regulations, explosive regulations, and expertise in other parts of society, such as the private sector. The secure management of digital data and documents is a familiar issue to the financial and banking sector.

Participation in verifying the destruction of conventional arms and chemical weapons—the latter including chemical agents, delivery systems, and the infrastructure needed to produce and handle the weapons—has also been the catalyst for a systematic effort to learn about training inspectors and developing procedures that they will use in their work. Participating in short-notice challenge inspections, either as inspectors or as an inspected party, has provided specific insights into how to plan for and manage future inspections.

At least some nuclear-armed states have become accustomed to inspections of different kinds. All nuclear fuel cycle facilities in the United Kingdom, apart from a fuel fabrication facility for submarine reactors, have already been placed under Euratom safeguards and are routinely inspected.[31] The United Kingdom has now participated in a fairly wide range of different types of inspection regimes, including safeguards inspections under the Euratom and IAEA frameworks, inspections to verify implementation of the CFE Treaty, and inspections to verify implementation of the CWC. The United

Kingdom also has invited visits from the IAEA International Physical Protection Advisory Service (IPPAS) to review U.K. arrangements for security in the civilian nuclear fuel cycle.

In a 2008 speech on French nuclear policy, former president Nicolas Sarkozy said: "I have decided to invite international experts to observe the dismantlement of our Pierrelatte and Marcoule military fissile material production facilities."[32] Site visits were conducted for separate audiences—diplomats, journalists, and non-government organizations and other experts between 2007 and 2010. However, dismantling and decommissioning these facilities is a huge and expensive task that is not yet complete, and there may still be opportunities for further activities to learn lessons.

FOREIGN INSPECTORS AND INFORMATION SECURITY

When receiving foreign inspectors, a central issue for the host will be how to manage various practical risks. First and foremost, countries need procedures to permit them to work with external partners. A first step in putting these in place is a national exercise to think through the issues and problems in the specific country context. While implemented nationally, such exercises could benefit from international discussion about how they should be framed, organized, and implemented.

Countries need procedures to permit them to work with external partners. A first step toward receiving foreign inspectors would be national exercises to frame problems in country-specific contexts.

The experiences from past activities could be harvested with a focus on specific capabilities. Some of these would be technical. The negotiation of inspection protocols could be compared across inspection regimes. Experience with the use of communications equipment, perhaps including encrypted transmissions, into and out of high security facilities could also be compared. Past experience could guide the management of issues such as the effects of export control laws and regulations on encryption products and technology for use in verification.

The assessment and use of available documentation in a high security area could also be a subject for collective analysis. Documentation may be in different forms, including narrative text, statistical data, and photographs. Where records are kept in digital form, it is unlikely that an outsider would be given access to the electronic systems where they are stored. The applicability of methods to authenticate electronic files to allow transmission to another party could be assessed. Similarly, the question of how to validate paper records printed from digital files is a technical skill that can be analyzed at the expert level.

Experience with chain-of-custody integrity verification can be gathered and compared to address the question of how to demonstrate the capability to manage information securely. If there is a nuclear weapon at a given location, or if a nuclear weapon is in

transit, assurances that this information will not be released in real time—including revealing locations, routes, dates, and names—will be an important element of building trust. Information relevant to the responsible management of chain of custody data could also include the analysis of unique identification tools, such as tags and seals in different processes, or the handling of data generated from cameras.

SCIENCE AND TECHNOLOGY

Some basic nuclear physics competence is required to participate in tasks that involve measurement and analysis in verification activities. The skill set would need to include the ability to conduct gamma ray measurements (dose rates and spectroscopy) and neutron detection. This expertise does not reside exclusively in states with nuclear weapons; it can be found in a country with nuclear medicine and x-ray technology. The health and safety aspects of inspections can also be analyzed based on many countries' experiences in implementing national regulations. The safety rules for personal conduct at nuclear facilities could be collected and compared, and all countries, even those without nuclear facilities, could compare rules for personal conduct in explosive-designated areas.

The potential role of commercial satellite imagery and other geospatial tools in understanding the implementation of nuclear arms reductions could be explored in specific contexts, such as the current status of decommissioned fissile material production sites, the implementation of U.S.-Russian arms control treaties, or the unilateral modification to nuclear force structures.[33] It is possible to use commercial satellite imagery to ascertain whether a reactor is operating through a variety of signatures that differ depending on the type of reactor and cooling system. At enrichment and reprocessing facilities, observing the presence or absence (and the nature) of activity at the location, as well as any structural disassembly or conversion, could provide valuable indications of operational status.

The United States and Russia have agreed to procedures that make the conversion and elimination of strategic offensive arms and facilities subject to the New START Treaty visible to national technical means of verification for a 60-day period following provision of notification.[34] Commercial satellites are able to capture these events. However, one difficulty is knowing when and where to look, as the notification process occurs confidentially between the United States and Russia. The structural evolution of sites known to support nuclear weapons, such as air and naval bases or specialized storage facilities, could be monitored after a removal declaration was made. Given the significant technical support required for nuclear weapon storage, maintenance, and operation, there would presumably be some observable changes to these sites if the nuclear role ceased.

The technical tools needed to collect and assess the relevant information are widely available. The technical skills needed to analyze and interpret the free images available

Source: Associated Press

Satellite image of North Korea's Yongbyon nuclear facility taken by GeoEye, April 30, 2012.

from Google Earth and the U.S. Geological Survey satellite imagery archives, as well as commercially purchasable imagery from, for example, SPOT, GeoEye, and Digital Globe, have been developed in many states. As the cost of acquiring commercial images has fallen, it is no longer a barrier to acquisition for most states, which are exploring the use of this technology in a range of contexts. An increasing number of countries are also investing in the development of national capabilities for nuclear forensic analysis. These skills will be applied to tasks such as combating international trafficking in nuclear materials.

The increasingly equitable distribution of relevant technology includes not only states, but also specialized non-state bodies and international organizations. These generic skills, which exist in countries regardless of whether or not they are armed with nuclear weapons, should be brought together and applied to the cooperative verification of nuclear arms reductions. As a starting point, existing projects could be identified, catalogued, and linked together in a sustainable framework. Updating the reporting in the United Nations system on disarmament training would be one way to collect this information.*

The availability of technology makes all things more visible, which is perhaps increasing the incentive to develop more managed engagement. Encouraging efforts to organize collaborative activities in ways that help to verify declarations, but do not reveal other sensitive or unrelated information, would help in the two-way trust building process. At the moment, inspectors who participate in New START learn the specific parameters for access to highly sensitive facilities in ways that are consistent with prevailing rules in dedicated training courses. This is a well-developed process that builds on training courses used in previous treaty verification implementation. A mock inspector training course, modeled on (but not part of) the New START inspection regime, could be designed so that it would be open to participation from all states.

SUSTAINABILITY

Developing the necessary global capacities to allow all interested states to play a productive role in cooperative verification will not be accomplished overnight; it is a process that will take a considerable period of time. A focused dialogue could be initiated to identify states that are willing to engage in projects in different configurations, including bilateral or small group cooperation on specific issues within an overall framework, as well as long-term cooperation within an ad hoc group of states or a regional or sub-regional configuration.

In the absence of specific tasks, sustaining engagement in a multi-year process will be challenging. One set of tasks can be organized around realistic but limited scenarios, as in the approach of the U.K.-Norway Initiative (UKNI). In feedback received by the United Kingdom and Norway, one general comment was that the actual verification cases might present "a more hostile environment in comparison with the cooperative scenario discussed by UKNI."[35] Cooperative projects to help establish the credibility of declarations by states that have decided, on their own initiative, to reduce nuclear forces or parts of their nuclear weapons complex might provide a supplementary focus that could help sustain cooperative efforts.

* One example of a relevant activity would be the Institute of Nuclear Materials Management workshop, "Preparing for Nuclear Arms Reductions: Addressing Technical Transparency and Verification Challenges," Monterey Institute of International Studies, Monterey, California, May 4–5, 2011.

The involvement of international agencies would also have to be considered. The objective of working toward creating a multilateral inspectorate in the long term could be the catalyst for thinking about which institutional framework could provide sustainability.* Cost would obviously be a factor where the financial climate for creating institutions is not permissive. An efficient way forward might be for a core group to define the efforts that would most benefit from including others in the near term and gain most efficiency from combining forces, rather than carrying out multiple bilateral engagements. Given the self-selecting group of states that have expressed interest in initiating further work on cooperative verification, a dedicated set of capacity-building courses and workshops involving nationals from those states would create a core group of a manageable size.

* The need to assemble a multinational, interdisciplinary team of inspectors at short notice to conduct chemical weapon–related inspections in Syria emphasized the key role the Organization for the Prohibition of Chemical Weapons and the World Health Organization play in maintaining a critical mass of experts with complementary skills.

5. Conclusions and Recommendations

As the number of nuclear weapons in the world continues to decline, there will be a shared interest in increased levels of vigilance and transparency by all states. Initiatives at the global, regional, and subregional levels can be mutually reinforcing and help build a shared commitment to all forms of nuclear risk reduction. It is possible for all states—those with nuclear weapons and those without nuclear weapons—to cooperate in meaningful ways on verification while preventing sensitive information that could contribute to a nuclear weapons program from being divulged.

States that decide to reduce their nuclear stockpiles will find it easier to win the trust of the international community if they have maintained clear and consistent records that describe key aspects of their nuclear programs. In developing systematic record keeping, states with nuclear weapons should think through the implications of moving from paper to digital records, including the potential questions arising over the authenticity of digital data. States that equip themselves with the necessary skills could play a valuable role in enhancing the confidence of the entire international community that promised reductions are implemented in good faith. States with and without nuclear weapons can better prepare themselves for such cooperation.

Even if a nuclear-armed state decided to reduce its nuclear-weapon holdings, very few countries could participate in a verification regime. Systematic capacity building would close this gap.

Political and technical expert communities tend not to work in an integrated framework, and as a result, there is a risk that information will be understood and interpreted differently. Both communities could benefit from projects that bring them together across functional lines. At the moment there are significant capability gaps at the national level in different countries. Even if a nuclear-armed state decided to reduce its nuclear weapon holdings, very few countries are in a position to participate in a verification regime. There is a need for systematic capacity building to close these gaps.

When building capacity, it is important to develop cooperative activities on the basis of networks that can combine skills from the military, academic, and private sectors—such as security, health and safety, data management, and material science. Regional approaches might also be a fruitful way to begin discussions on future efforts. Making efforts sustainable over an extended period could be explored in a number of ways.

States with and without nuclear weapons can undertake actions now that will lay the groundwork for a more collaborative approach to verification in the future.

RECOMMENDATIONS

Recommendations are grouped in three categories for states with nuclear weapons, states without nuclear weapons, and both groups collectively that will help to create a sense of common enterprise and solidarity.

States with nuclear weapons should

- **Determine national inspection sensitivities.** If states with nuclear weapons intend to work with states without nuclear weapons, they need to begin by ascertaining what knowledge, methodologies, and technologies can be shared without revealing sensitive information that could contribute to proliferation.
- **Establish, reestablish, or expand government programs dedicated to verification.** Dedicated government programs are required to devote the necessary resources to the task and to ensure efforts are sustainable over the long haul.
- **Share information on risk management associated with inspections.** States with nuclear weapons can learn a great deal from each other about how inspections at sensitive facilities are managed. Sharing lessons learned will be useful and, eventually, facilitate engagement with states without nuclear weapons.
- **Preserve program records, supporting data, knowledge, and institutional memory.** As the experience of South Africa described in this report shows, better documentation can increase the level of confidence in verification findings and reduce workloads. Maintaining clear and consistent records makes demonstrating compliance much easier.
- **Engage all nuclear-armed states in the dialogue on the glossary of concepts and definitions applied in nuclear arms control.** The NWS are developing a common understanding of concepts and definitions that will be helpful in streamlining collaborative nuclear activities. Engaging other nuclear-armed states on this topic could be a productive next step and build broader capacity for verification.

- **Evaluate how to make unilateral modifications to force size, structure, and posture more transparent.** Such actions have near-term benefits to confidence and long-term value by creating working relationships, demonstrating proof of concept for greater openness, and building a catalogue of tools and procedures that could be brought into future verification activities.

States without nuclear weapons should

- **Determine what they want to achieve from engagement in a verification process.** States without nuclear weapons need to develop a basic understanding of the benefits and limitations of verification to determine the value of engaging and the return that can be expected on that investment.
- **Promote academic programs that build verification skill sets.** Promoting specific programs with verification applications will help interested countries build capacity in functional areas.
- **Establish a government program dedicated to verification and identify a lead authority.** Just as in states with nuclear weapons, dedicated government programs in states without nuclear weapons are required to devote the necessary resources to the task and ensure efforts are sustainable over the long haul.

States with and without nuclear weapons collectively should

- **Share basic information related to definitions, methodologies, instruments, and relevant technologies.** Sharing basic information helps to facilitate cooperation by identifying similarities and differences and minimizing miscommunications.
- **Jointly develop academic curricula that build awareness about verification concepts.** Academic programs should provide basic knowledge, build capacity in functional areas, and promote sustainability.
- **Conduct site visits at nuclear facilities.** Preliminary site visits will help to acclimate hosts and visitors to safety and security requirements. This is sometimes referred to as managed access.
- **Share experiences and lessons learned from existing verification activities.** Experiences should not be limited to the nuclear realm and could include regimes such as the Chemical Weapons Convention.
- **Explore regional approaches to capacity building.** Different countries possess different skills that can be found in the government, military, academic, and private sectors. These should be brought together. Useful first steps include identifying regional champions for the verification mission and establishing a

group of interested parties that will conduct joint outreach on verification issues through activities such as dedicated workshops.

- **Design and conduct a mock inspector training course.** This course could be modeled on the New Strategic Arms Reduction Treaty inspection regime, open to participation from states with and without nuclear weapons, to share lessons learned from decades of U.S. and Russian experience.
- **Conduct joint development, testing, and certification of verification tools and nuclear forensics.** Joint development is an extremely effective way to build both knowledge and trust among partners.
- **Develop common understandings of information security processes and procedures.** Even if the information security processes of interested countries are not similar, understanding the similarities and differences will make cooperation much easier.

6. Endnotes

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ABOUT THE NUCLEAR THREAT INITIATIVE

The Nuclear Threat Initiative (NTI) is a non-profit, non-partisan organization with a mission to strengthen global security by reducing the risk of use and preventing the spread of nuclear, biological, and chemical weapons and to work to build the trust, transparency, and security that are preconditions to the ultimate fulfillment of the Non-Proliferation Treaty's goals and ambitions.

Founded in 2001 by former U.S. Senator Sam Nunn and CNN founder Ted Turner, NTI is guided by a prestigious, international board of directors. Joan Rohlfing serves as president.

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"Deterrence in the Age of Nuclear Proliferation,"
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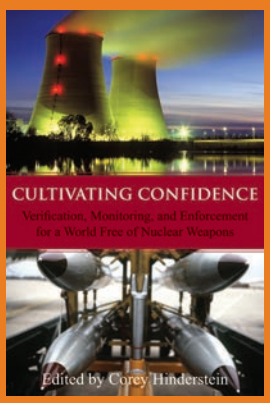

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